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THE ISTHMUS OF PANAMA AND THE KNOWLEDGE ANTHROPOCENE

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In the final chapter of *Man and Nature*, his landmark 1864 study of an earth transformed by human action, George Perkins Marsh looked ahead to a series of “projected or possible geographic changes by man,” including the “cutting of marine isthmuses.” He had in mind efforts like the Suez Canal, then under construction, which he celebrated as “the greatest and most truly cosmopolite physical improvement ever undertaken by man.” While Marsh was an early critic of the human capacity to upset nature’s harmonies, and the founder of a modern conservation movement aimed at blunting human improvidence, he could be surprisingly sanguine about such megaprojects. As his biographer David Lowenthal noted, Marsh “was an absorbed observer—now admiring, now alarmed—of huge engineering works.” Indeed, *Man and Nature*, though a cautionary book, often praised humanity’s escape from the determinist powers of nature. As Marsh put it in an 1860 letter to Spencer Baird, while many leading geographers of the era taught “that the earth made man”—that human history and culture were deeply shaped by environmental forces and circumstances—his book would show that “man in fact made the earth”—that humans finally had become, as he put it in *Man and Nature*, “truly a geographical agency.”¹



Open-pit coal mine, Hambach, Germany. © Bernhard Lang. All rights reserved.

But geographical agency came with responsibility. After touting the revolutionary nature of massive canal projects, Marsh turned to the “alarming uncertainty as to the effects of joining together waters which nature has put asunder.”² His concerns focused on a proposed interoceanic canal across the Isthmus of Darién, then the Central American route favored by explorers, the US government, and the private capitalists most likely to undertake the project. Marsh wrote *Man and*

Nature at a pivotal moment in the history of the Darién scheme. A decade earlier, in 1854, the highly publicized US Darién Expedition went in search of a prophesied low route across the region. But the commander, Isaac Strain, and his party became hopelessly lost, wandering aimlessly for seven weeks in the rugged forests of the Darién. Six of his men starved to death, and the rest emerged from the jungle in dire shape. Still, the disastrous Strain expedition did not quell enthusiasm for the Darién route, as Marsh's discussion suggested. Not until the early 1870s, when Commander Thomas O. Selfridge Jr. led another US Navy expedition to the region and made it clear that such an easy route was a chimera, would the proposed Darién canal fade from history.³



Return of Commander Selfridge and his Reconnaissance Party from an Expedition in the Interior of Darién. © 1870 Timothy H. O'Sullivan. Gilman Collection, Museum Purchase, 2005. [Public domain](#).

I first encountered Marsh's thoughts on the cutting of marine isthmuses, and on the Darién route in particular, while researching the history of the Panama Canal. One of the central themes of my work is how US officials and other observers boasted about the completed canal as an imperial engineering achievement that overcame a hostile tropical environment.⁴ I was curious to see what Marsh might have to say about the tropics and the capacity for human geographical agency within the region. But Marsh's concerns about the Darién canal had nothing to do with the tropics. Instead, he wrote of the threat such a canal would pose to the workings of a global climate system just coming into scientific view. Although his concerns initially struck me as outlandish, I soon realized they were rooted in a series of discoveries about the earth and its history that would make our modern concept of the Anthropocene possible. This is a story about those discoveries, told through George Perkins Marsh's musings about an unrealized canal.

Marsh assumed that the proposed Darién canal would be an “open cut between the two seas,” and he worried that the canal would inevitably be widened and deepened by an erosive ocean current flowing through it. Such a widening of the canal aperture might, in turn, change the course of the Gulf Stream, which delivered warm waters from the tropics to the North Atlantic, moderating Western Europe’s climate. A diminution of the Gulf Stream’s power, or even its wholesale redirection through the canal and into the Pacific, might result, Marsh speculated, in “an immediate depression of the mean temperature of Western Europe to the level of that of Eastern America.” He even suggested that a new “ice period” might be “occasioned by the withdrawal of so important a source of warmth from the northern zones.” The consequences of a sea-level Darién canal, he feared, would be “not inferior in magnitude to any physical revolution which has ever taken place since man appeared upon the earth.”⁵

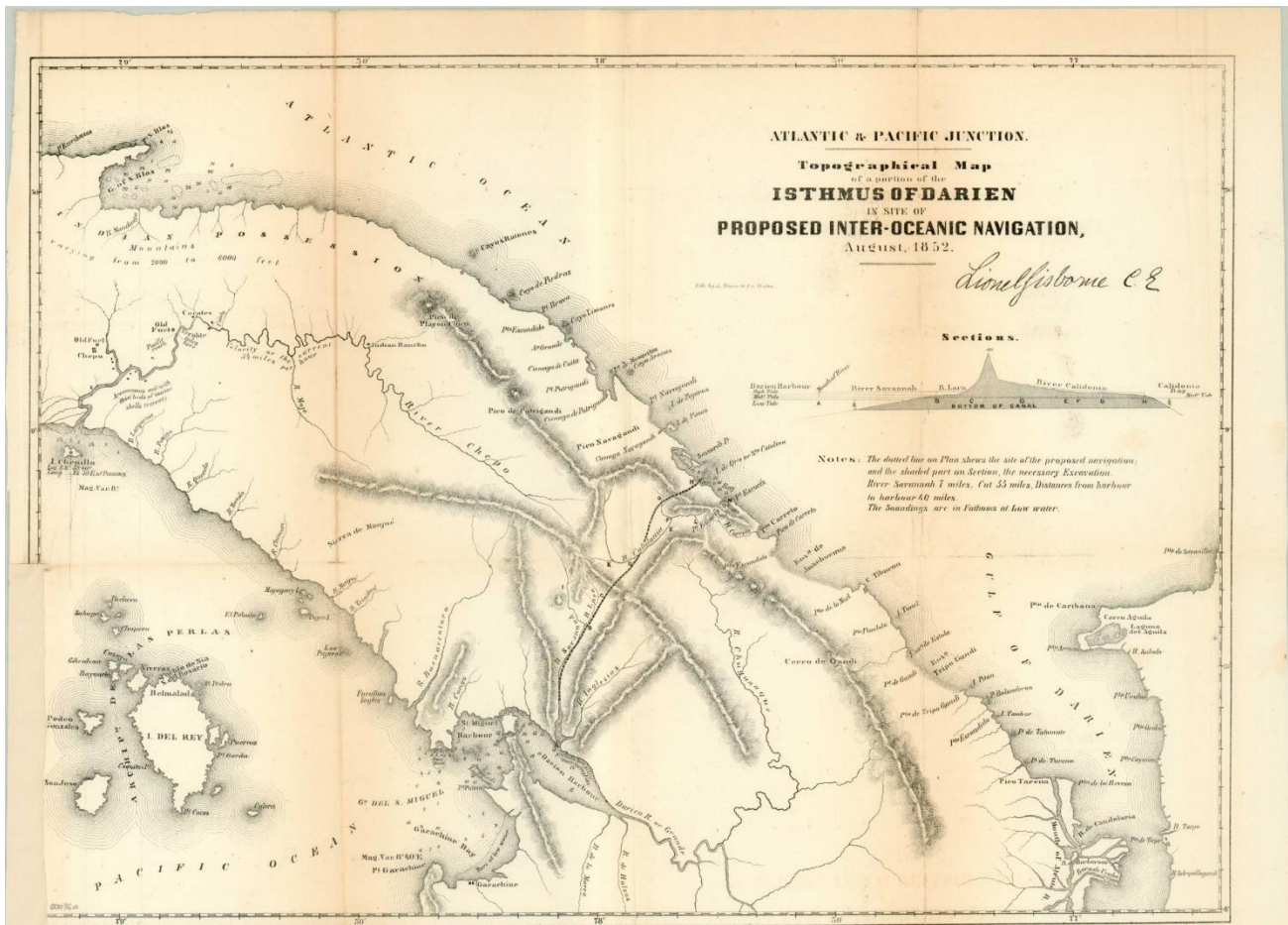
Marsh’s discussion marked a prominent early appreciation of the capacity of human actions to deflect global climate in troubling ways.

It would be easy to dismiss such fears as fabulous. Marsh clearly overestimated the scale of the proposed sea-level canal and its capacity to eat away at the isthmus and divert the Gulf Stream. But his concerns are more significant than they might appear at first blush. For one thing, his discussion, which came decades before the Swedish scientist Svante Arrhenius first suggested that human carbon emissions might warm the climate, marked a prominent early appreciation of the capacity of human actions to deflect global climate in troubling ways. And Marsh was not wrong to raise the alarm about a diminished Gulf Stream. Today we recognize the Gulf Stream, and the larger Atlantic Meridional Overturning Circulation (AMOC) of which it is a part, as critical to the earth’s climate system, a conveyor belt that pulls warm water from the tropics northward. And, as I write, the AMOC may be slowing—not because of a breach in the Panamanian isthmus but because a cold blob of water from the melting Greenland ice cap may be disrupting its flow. For very different reasons, Marsh’s mid-nineteenth-century fears have become ours.⁶

What Marsh knew about the mechanics of all of this is not entirely clear. The only reference he provides for his speculation is a lengthy quote by the German scientist Georg Hartwig and his 1857 book, *Das Leben des Meeres* (The Life of the Sea).⁷ But the Gulf Stream was a well-known phenomenon by the 1860s. Ponce de Léon first noticed the Gulf Stream’s current in 1513, and early European explorers and traders used it to their advantage. By the late 1700s, Benjamin Franklin had popularized the term “Gulf Stream” and, with his cousin Timothy Folger, charted its course as an aid to navigation. The Gulf Stream later received a thorough mapping by the antebellum US oceanographer and proslavery ideologue Matthew Fontaine Maury, who referred to it as a “river in the ocean” and used the sweeping ocean currents as one justification for imagining the Amazon as the next frontier of the American slavocracy. Maury was also among the earliest to recognize the Gulf Stream’s formative role in shaping Europe’s mild climate.⁸ And the whaler and marine scientist William Scoresby had, as early as the 1810s, used his “marine diver” to measure subsurface water temperatures in the far northern Atlantic, establishing the existence of warm water deep below the surface that helped to drive the AMOC’s overturning circulation. The AMOC’s mechanics would not be fully understood until the late twentieth century. Finally, several scientists, including biologist and geologist Louis Agassiz, had pieced together a theory of past ice ages in the decades before Marsh wrote, allowing him to imagine the climatic consequences of the Gulf Stream’s demise.⁹

Marsh likely did not know that what he feared had once been a geographical reality. By the late 1860s, scientists began to theorize that the Isthmus of Panama and the Gulf Stream had not always existed. Early evidence of such geological dynamism would soon be pieced together by the zoologist Albert Günther, and, by the fifth edition of *On the Origin of Species* (1869), Charles Darwin had taken notice of Günther’s work: “Dr. Günther has recently shown that on opposite sides of the isthmus of Panama, about thirty percent of the fishes are the same; and this fact has led naturalists to

believe that the isthmus was formerly open.” Today, it is settled science that the geological formation of the Isthmus of Panama occurred several million years ago (though there is still debate about exactly when) and that it redirected tropical ocean currents into the North Atlantic, creating the Gulf Stream. Thus, while Marsh was alarmist in worrying that the Darién canal would alter major ocean currents, he was not entirely wrong about the role that the Isthmus of Panama played in shaping them.¹⁰



Topographical map of a portion of the Isthmus of Darién at the site of the proposed interoceanic navigation. Unknown creator, 1852. Courtesy of Map and Imagery Library, George A. Smathers Libraries, University of Florida. [Public domain](#).

Marsh’s speculations about the Darién canal and the Gulf Stream point to what I call a “Knowledge Anthropocene,” a transformation in Western understandings of earth history. Marsh fretted about the potential effects of the proposed Darién canal amidst a rapid acceleration in knowledge about the relationship between geology, geography, ocean currents, and climate—knowledge that has become critical to our understanding of the global climate system today. His concerns were prescient in recognizing the human capacity to alter oceanic currents and affect climate; they were also part of a larger intellectual enterprise that changed our understandings of earth systems as rapidly as humans were changing the earth. In the literature on the Anthropocene—the so-called human epoch—Marsh is routinely cited as a foundational figure, one of the first people to recognize the outsized power that humans (or at least certain humans) were coming to exercise over the material environment.¹¹ “Man,” as he famously put it, “was everywhere a disturbing agent.” But this literature on the materialism of the Anthropocene has not always noticed the deep undercurrent of burgeoning scientific knowledge that has made our contemporary understandings of planetary human impacts possible.¹²

Fundamental to the Knowledge Anthropocene was a revolution of the understanding of deep time that developed among savants across the late eighteenth and nineteenth centuries. Transformative changes in the fields of geology and evolutionary biology led the way. As humans dug deeper into the earth, in some cases to mine and harness the fossil energy of coal, they found stratigraphic and fossil evidence of a planet, and the life upon it, that had evolved over millions, perhaps even billions, of years. This dawning appreciation for earth's deep history is, of course, well known to historians of science, but my interest here is in how this intellectual sea-change reshuffled the relationship between nature and history in Western thinking. Prior to this revolution in deep time, most assumed earth history and human history were roughly coterminous; afterwards, scientists came to understand that the earth had an unfathomably long history before humans arrived on the scene. One result is that human history and earth history were cleaved in two, a development that helped to solidify the idea that there was a nature that existed before, and even outside of, history, one that humans had become capable of dominating and disturbing.¹³

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But there was also a countervailing trend. Even as nature came to sit outside of human history, the late-nineteenth-century historian's sensibility—which was only then developing in its modern form among professionalizing historians—intruded upon the scientific study of the environment. Nature became a vast realm for studying change over time, contingency, complexity, and context—all signature features of historical thinking. Again, we see this most obviously in the fields of geology and evolutionary biology, the so-called historical sciences, but it was a broader change than that. Many scientists came to see the more-than-human world not as a product of divine creation or timeless natural laws, but of discrete events playing out over time. They came to understand that “nature is history.” While that phrase might evoke an Anthropocene world of permeating human influence, it has two other important meanings: the more-than-human world has always been a product of history, and “Nature” as a unified realm separate from the human world is an idea whose time has come and gone.¹⁴

The environmental sciences behind the Anthropocene developed not only as sciences with a historical sensibility, but also with a sense of the natural world as a multiplying series of archives. An understanding of earth's deep history developed as chronologists turned away from human sources such as the Bible and toward what we might call environmental archives. For Albert Günther, the comparative anatomies of contemporary fishes were his archive, and they helped him to imagine a past in which the Isthmus of Panama had been permeable. For others, geological strata and their embedded fossil remains told of earth events in the distant past, former regimes of life, the dynamism of species, and the reality of extinction. Historical ecologists and climatologists came to use pollen deposits, packrat middens, tree rings, and other repositories to reconstruct past landscapes and climates, while atmospheric scientists read the air bubbles in ice cores to reconstruct the atmospheres of past ages. More recently, phylogeneticists have found in DNA powerful tools for understanding the histories of species. Even human archives have sometimes become environmental archives. For instance, historians have begun working with geneticists to study the DNA in medieval manuscript parchments made from animal skins, which may allow them to answer questions not only about the manuscripts themselves but also about the history of humans and their livestock during the period. These are just some of the ways in which environmental archives have informed planetary history. The Knowledge Anthropocene has been a fundamentally archival enterprise.¹⁵



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The knowledge revolution that made our modern understandings of the Anthropocene possible has worked, albeit quite slowly, to give us a more-than-human world that is thoroughly the product of history, one that increasingly functions as a series of archival resources with which to reconstruct that history. In the process, the holy duality of Marsh’s “man and nature”—the separation of nature and culture that has been so central to modernist traditions of environmental understanding—has been eroding away. We have already seen evidence of how those shifting currents have begun to alter the climate of environmental history and the environmental humanities—in Dipesh Chakrabarty’s study of the collapsed distinction between natural and human history and Amitav Ghosh’s call for new literary, historical, and political narratives that can imaginatively knit these realms together.¹⁶ We have also seen such evidence in previous scholarship on big history and deep history.¹⁷ My point here is more modest: the Knowledge Anthropocene has helped us to historicize the world, given us the tools for writing new humanist narratives of worldmaking, and suggests that historical habits of mind should play a more central role in global problem-solving. Rather than bringing the insights of science to history, as environmental historians have long done, we need to bring the insights of history to science.

¹ George Perkins Marsh, *Man and Nature*, ed. David Lowenthal (Seattle: University of Washington Press, 2003), 437–42; David Lowenthal, *George Perkins Marsh: Prophet of Conservation* (Seattle: University of Washington Press, 2000), 267, 279.

² Marsh, *Man and Nature*, 438.

³ Todd Balf, *The Darkest Jungle: The True Story of the Darien Expedition and America’s Ill-Fated Race to Connect the Seas* (New York: Crown Publishers, 2003); Thomas Oliver Selfridge, *Reports of the Explorations and Surveys to Ascertain the Practicability of a Ship-Canal between the Atlantic and Pacific Oceans by Way of the Isthmus of Darien* (Washington, DC: GPO, 1874).

⁴ Paul S. Sutter, "Nature's Agents or Agents of Empire? Entomological Workers and Environmental Change during the Construction of the Panama Canal," *Isis* 98, no. 4 (December 2007): 724-54; Sutter, "Triumphalism and Unruliness during the Construction of the Panama Canal," in "Unruly Environments," eds., Siddhartha Krishnan, Christopher Pastore, and Sam Temple, *RCC Perspectives: Transformations in Environment and Society*, no. 3 (2015): 19-24.

⁵ Marsh, *Man and Nature*, 441-42.

⁶ Moises Velasquez-Manoff and Jeremy White, "In the Atlantic Ocean, Subtle Shifts Hint at Dramatic Climate Dangers," *New York Times*, 2 March 2021, <https://www.nytimes.com/interactive/2021/03/02/climate/atlantic-ocean-climate-change.html>.

⁷ Marsh, *Man and Nature*, 442-43.

⁸ Stan Ulanski, *Gulf Stream: Tiny Plankton, Giant Bluefin, and the Amazing Story of the Powerful River in the Atlantic* (Chapel Hill: University of North Carolina Press, 2008), x, xii, 14, 31, 47. The Maury quote is from *The Physical Geography of the Sea* (New York: Harper & Brothers, 1855), 25. On Maury's visions for the Amazon, see Gerald Horne, *The Deepest South: The United States, Brazil, and the African Slave Trade* (New York: New York University Press, 2007), 107-27; Walter Johnson, *River of Dark Dreams: Slavery and Empire in the Cotton Kingdom* (Cambridge, MA: The Belknap Press of Harvard University Press, 2013), 280-302.

⁹ On Scoresby, see Gillen D'Arcy Wood, *Tambora: The Eruption that Changed the World* (Princeton, NJ: Princeton University Press, 2014), 135-38. On the ice-age discoveries, see Martin J. S. Rudwick, *Earth's Deep History: How It Was Discovered and Why It Matters* (Chicago: University of Chicago Press, 2014), 174-85.

¹⁰ Albert Günther, "An Account of the Fishes of the States of Central America, Based on the Collections Made by Capt. J. M. Dow, F. Godman, Esq., and O. Salvin, Esq.," *Transactions of the Zoological Society of London* 6 (1868): 377-402. On Günther's influence, see Harilaos A. Lessios, "The First Stage of Speciation as Seen in Organisms Separated by the Isthmus of Panama," in *Endless Forms: Species and Speciation*, eds., Daniel J. Howard and Stewart H. Berlocher (New York: Oxford University Press, 1998), 186-201, p. 187. On the formation of the Isthmus, see Aaron O'Dea, Harilaos A. Lessios, Anthony G. Coates, Roni I. Eytan, Sergio A. Restrepo-Moreno, Alberto L. Cione, Laurel S. Collins et al., "Formation of the Isthmus of Panama," *Science Advances* 2, no. 8 (2016): e1600883. <https://www.science.org/doi/10.1126/sciadv.1600883>; Alex Farnsworth and Emma Stone, "How Events in Panama Created the Modern World (Millions of Years Ago)," *The Conversation*, 20 May 2016, <https://theconversation.com/how-events-in-panama-created-the-modern-world-millions-of-years-ago-58357>.

¹¹ See, for example, Will Steffen, Paul J. Crutzen, and John R. McNeill, "The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?," *AMBIO: A Journal of the Human Environment* 36, no. 8 (December 2007): 614-21; Erle C. Ellis, *The Anthropocene: A Very Short Introduction* (New York: Oxford University Press, 2018), 12.

¹² Marsh, *Man and Nature*, 36.

¹³ Rudwick, *Earth's Deep History*.

¹⁴ Thomas Andrews and Flannery Burke in "What Does it Mean to Think Historically," *Perspectives on History*, January 2007, <https://www.historians.org/research-and-publications/perspectives-on-history/january-2007/what-does-it-mean-to-think-historically>. On the development of the discipline of history and its marginalization of the nonhuman world, see Dipesh Chakrabarty, "The Climate of History: Four Theses," *Critical Inquiry* 35, no. 2 (Winter 2009): 197-222; Chakrabarty, *The Climate of History in a Planetary Age* (Chicago: University of Chicago Press, 2021). On the idea that "nature is history," see Paul S. Sutter, "The World with Us: The State of American Environmental History," and "Nature Is History," *Journal of American History* 100, 1 (June 2013): 94-119, 145-48.

¹⁵ My thinking here has been influenced by Lorraine Daston, "The Sciences of the Archive," *Osiris* 27, no. 1 (2012): 156-87; and Megan Raby, "Ark and Archive: Making a Place for Long-Term Research on Barro Colorado Island, Panama," *Isis* 106, no. 4 (December 2015): 798-824. On studies of medieval manuscripts, see Sarah Zhang, "The Lab Discovering DNA in Old Books," *The Atlantic*, 19 February 2019, <https://www.theatlantic.com/science/archive/2019/02/dna-books-artifacts/582814/>; Sean P. Doherty, Michelle M. Alexander, Stuart Henderson, Jason Newton, Jonathan Finch, and Matthew J. Collins, "Tracking the British Agricultural Revolution through the Isotopic Analysis of Dated Parchment," *Scientific Reports* 13, no. 61 (2023), <https://doi.org/10.1038/s41598-022-26013-4>.

¹⁶ Chakrabarty, "The Climate of History"; Amitav Ghosh, *The Great Derangement: Climate Change and the Unthinkable* (Chicago: University of Chicago Press, 2016).

¹⁷ David Christian, *Maps of Time: An Introduction to Big History* (Berkeley: University of California Press, 2004); Dan Smail, "In the Grip of Sacred History," *American Historical Review* 110, no. 5 (December 2005): 1337-61; and Smail, *On Deep History and the Brain* (Berkeley: University of California Press, 2008).



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